Appendix E. Bridge and road access

This appendix was prepared by The Boutet Company and presents descriptions of the design elements for a new bridge and connecting roads. Estimates of project construction and maintenance costs for these elements are also provided.

Figure 1 presents a map of the existing Naknek and South Naknek highways (purple lines), and the proposed bridge and roadways (orange lines). This map also illustrates a potential crossing site for the potential bridge.

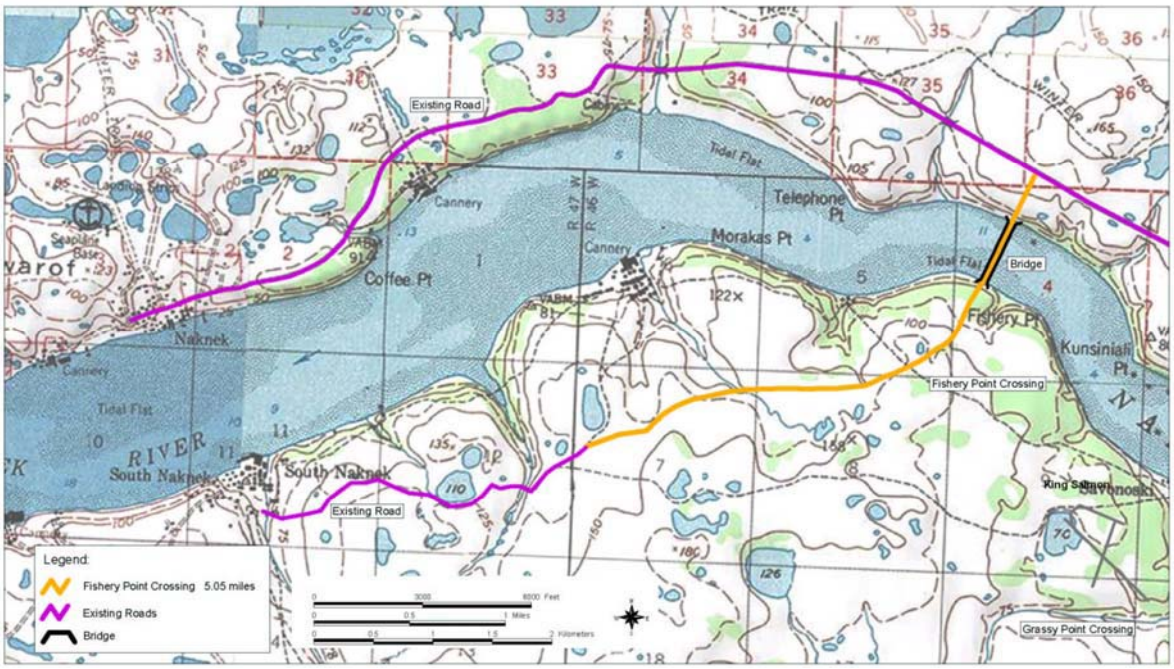

Figure 1. Road and bridge facility concept

Source: The Boutet Company

Capital and operating cost estimates were made for three levels of development. All estimates were based on the Fishery Point bridge alignment as described in the DMJM Bridge Location Study (reference 3.)

Capital costs

High build option

The High Build option was based on constructing a metalized steel girder bridge and 2.75 miles of paved road to connect the existing streets in South Naknek with the Naknek – King Salmon Road. The following design features were taken from the current DOT&PF *Pre-Construction Manual* (reference 4) using **Rural Local Roadway** standards.

Access Road

Design Speed: 50 mph

Length: 14,500 feet (Scaled from reference 14)

Road Width: 24 feet with 3 foot shoulders (Reference 4, Table 1130-3)

4:1 slopes to edge of clear zone (21 feet from centerline)

2:1 slopes to edge of fill

All section in fill

Select Borrow Thickness: 4 feet (minimum)

Crushed Aggregate Base Thickness: 6 inches

Asphalt Concrete Thickness: 4 inches

Drainage: A 52 linear feet X 18-inch culvert for every 250 feet of road

Highway Signs: As necessary

Bridge

Length: 2,300 feet (DMJM Study)

Width: 33 feet

Figure 2 shows an example of a steel span girder bridge. This bridge on the Glenn Highway spans the Matanuska River between Anchorage and the cities of Palmer and Wasilla.

Figure 2. Steel span girder bridge across the matanuska river

Medium build option

The Medium Build option was based on constructing a metalized steel girder bridge and 2.75 miles of gravel road to connect the existing streets in South Naknek with the Naknek – King Salmon Road. The following design features provide for less frost protection with the understanding that maintenance grading will be required at least twice each summer.

Access Road

Design Speed: 50 mph

Length: 14,500 feet (Scaled from reference 14)

Road Width: 24 feet with 3 foot shoulders (Table 1130-3)

4:1 slopes to edge of clear zone (21 feet from centerline)

2:1 slopes to edge of fill

All section in fill

Select Borrow Thickness: 2 feet minimum

Gravel Surface Course Thickness: 6 inches

Drainage: A 48 linear feet X 18 inch culvert for every 250 feet of road

Highway Signs: As necessary

Bridge

Length: 2,300 feet (from reference 3)

Width: 33 feet

Low build option

The Low Build option was based on constructing only a metalized steel girder bridge. The connecting roads would be built by the Bristol Bay Borough to **Local Rural Road** standards.

Bridge

Length: 2,300 feet (from reference 3)

Width: 33 feet

Capital cost estimates

The capital cost estimates for the three options were calculated using quantities from the above criteria and unit prices from DOT&PF bid tabs, with the most emphasis given to unit prices from references 6 and 7, which are contemporaneously under construction.

The largest item for each option is the bridge. The unit price of $182.50 to $300 per square foot of bridge deck was derived from several sources. Initially, the Comparative Bridge Costs, Caltrans, January, 2002 and the STIP Planning Estimate Naknek, River Bridge, DOT&PF, 2002 (references 2 and 3) were used.

The Caltrans table lists a range of $150 to $215 per square foot inclusive, of 10% mobilization and 25% contingency. Factors indicating that the lower range unit prices are applicable include:

- Normal structure height
- No aesthetic issues,
- No bridge skew,
- No cantilever abutment,
- No re-routing of traffic and
- Single stage construction.

Factors indicating the higher range unit prices are applicable include:

- Long spans, environmental constraints
- Small project (compared to Caltrans freeway projects)
- Wet conditions
- Remote location and
- Pile footings.

These factors were considered to be compensating, so the mid-range unit price of $182.50 per square foot was selected. To account for the higher price of construction in bush Alaska, we excluded mobilization and contingency from the unit price and included these items elsewhere in the estimate.

This compared favorably with the unit price of $165 per square foot used in reference 5 and a published Maine Department of Transportation bridge study from 2001 that was also consulted.

Cost estimates for the three options using the unit price of $182.50 per square foot were submitted for review and comment by the project team. In response, we received input from Richard Pratt, Alaska State Bridge Engineer (reference 12). He cited two sources in support of a unit price of $300 per square foot and suggested that the bridge steel be metalized to obviate the need for periodic maintenance painting. This unit price was selected as the upper range. The $182.50 per square foot was selected for the lower range. These prices are reflected in the Recap table below. The itemized details for these estimates are shown in the attached Estimax spreadsheets for each option.

A cost estimate for a 44' X 700' pre-cast concrete bridge being designed for Unalaska/Dutch Harbor was obtained from Tryck, Nyman and Hayes (reference 15). The estimated square foot cost of this bridge is $239. At 40% of the size of the bridge proposed at Fishery Point, it would be dangerous to extrapolate this cost; but it does verify the range of prices given above.

Pre-cast concrete bridges are commonly limited to 150 foot spans, while Steel Girder bridges commonly have spans up to 300 feet. For the Fishery Point Crossing, a pre-cast concrete bridge would require 13 footings in the river, while a steel girder bridge would need 6. Since these footings will be driven into river silt of unknown depth and be required to resist ice scouring in both directions, they are expected to be costly. For this reason, the steel girder bridge was assumed to be the more economical type for this location.

This decision will be re-visited during the Design Study Report stage after foundation field investigations have been performed.

Capital Cost Estimates Recap

High Build Option. New steel girder bridge with 2.75 miles of paved road.

	High Range	Low Range
Construction Contract:	$27,092,100	$18,173,850
Construction Contingency @15%:	$4,063,815	$2,726,078
Design, Construction Admin. & ICAP @30%:	$8,127,630	$5,452,155
Grand Total (say):	$39,500,000	$26,250,000

Mid Build Option. New steel girder bridge with 2.75 miles of gravel road.

	High Range	Low Range
Construction Contract:	$25,356,325	$16,438,075
Construction Contingency @15%:	$3,803,449	$2,465,711
Design, Construction Admin. & ICAP @30%:	$7,606,898	$4,931,423
Grand Total (say):	$37,000,000	$24,000,000

Low Build Option. New steel girder bridge with roads constructed by others.

	High Range	Low Range
Construction Contract:	$24,354,000	$15,435,750
Construction Contingency @15%:	$3,653,100	$2,315,363
Design, Construction Admin. & ICAP @30%:	$7,306,200	$4,630,725
Grand Total (say):	$35,500,000	$22,500,000

Operating costs

Road maintenance costs are difficult to estimate for several reasons:

- Maintenance operations are rarely tracked on a route-specific basis and thus cannot disaggregated by roadway cross-section or surface type;
- O & M organizations are chronically under-funded, so the levels of maintenance "service" vary widely throughout communities because of variability in climate, roadway conditions, and other considerations.
- O & M funding has been declining on a per-mile basis, because of reduced State operating revenues, elimination of revenue sharing with local governments, inflation, and system expansion.

The analysis for this report considered two sources. The cost of gravel road maintenance was calculated using data from a spreadsheet titled "Nelson Island Transportation System Operation and Maintenance Cost Model" provided by Alan Kemplen (reference 10). The cost of paved road maintenance was calculated from summary data for the King Salmon

Maintenance Station provided by Alan Kemplen (reference 10) after deducting costs for contract airport maintenance and King Salmon, Naknek and South Naknek Airports shown elsewhere in this study.

Although there was some variance in the costs derived from these sources, the uncertainties discussed above resulted in a recommendation that O&M costs be considered equal for either an asphalt or gravel surfaced road. The following annual operating and maintenance requirements for the bridge and road are estimated.

Table 1. Operation and Maintenance Summary

Project Element	Maintenance Activity	Elements	Annual Cost
Metalized Steel Girder Bridge	Paved Deck Maintenance	Annual crack-sealing and pothole repair	$3,750 per lane mile
Gravel Road	Ongoing maintenance	Surface grading Replenishment of surface course Culvert and ditch cleaning Snow plowing and culvert thawing	$7,500 per lane mile
Paved Road	Ongoing maintenance	Crack sealing Pothole repair Culvert and ditch cleaning Snow plowing Culvert thawing	$7,500 per lane mile

Total annual operating costs for the bridge and access road are summarized in Table 2.

Table 2. Annual Operating Cost Summary

Build Option	Element	Annual Cost
Low-Build	Bridge Pavement Maintenance	$3,300
	TOTAL	$3,300
Medium Build	Bridge Pavement Maintenance	$3,300
	Gravel Road Maintenance	$41,250
	TOTAL	$44,550
High Build	Bridge Pavement Maintenance	$3,300
	Paved Road Maintenance	$41,250
	TOTAL	$44,550

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